Model IR700

Infrared Point Detector for Carbon Dioxide Gas Detection Applications

Instruction Manual **12-11**

MANIR700

Part No. **MANIR700**
Revision **A/12-11**

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Mounting and Orientation

The Model IR700 should be mounted horizontally (Figure 1) to reduce the likelihood of dirt and dust build-up on the windows. For optimum performance, the splashguards should be located on the top and bottom as shown in Figure 1. Apply the supplied thread lubricant/sealant to all conduit entries before use to prevent binding.

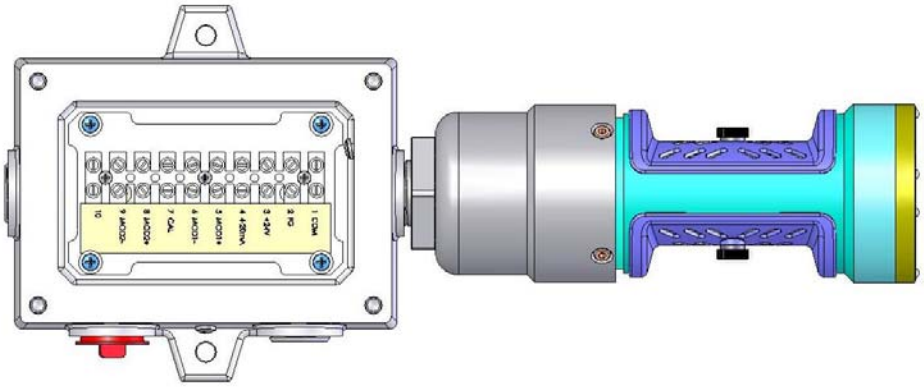

Figure 1: IR700 with Junction Box

Wiring Connections

TERMINAL	WIRE COLOR	SIGNAL
1	BLACK	COM
2	GREEN	FIELD GROUND (FG)
3	RED	+24 V
4	WHITE	4-20 mA
5	BLUE	MOD1+
6	WHT/BLU	MOD1 -
7	BROWN	CAL

Table 1: Wiring Chart

NOTE: Power should remain disconnected until all other wiring connections are made.

Power Connections

To supply power to the IR700, connect the red lead from the IR700 to the +24 VDC terminal on the power supply. Connect the black lead from the IR700 to the power supply Common. Refer to the manual of the power source being used, for more detailed instructions.

Applying Power

Before applying power to the system for the first time, all wiring connections should be checked for correctness. Upon initial power-up, the unit will enter a start-up mode for 2 minutes. During start-up, analog output will be 0 mA, 1.25 mA, or 3.5 mA depending on whether the communications option is Modbus, HART 1.25 mA, or HART 3.5 mA, respectively.

After power is applied, the IR700 should be allowed to stabilize for approximately 60 minutes while the unit attains the proper operating temperature. After stabilization, it is recommended that the IR700 be zeroed, per the procedure in section 4.1 (zero only). A gas check should then be performed to ensure that the unit is operating properly. Use the General Monitors Gas Check Kit (P/N 31478-1) to perform this check.

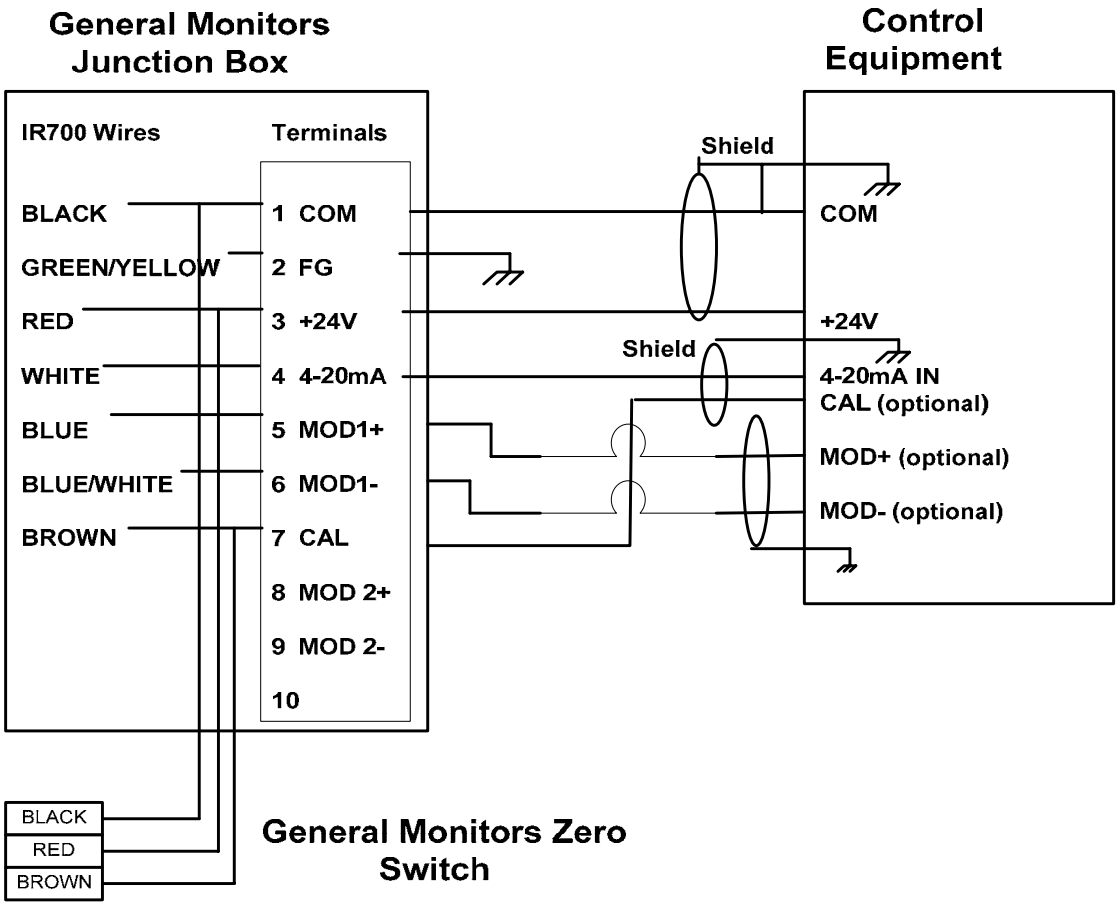

Figure 2: Wiring Diagram from IR700 to Control Equipment

The instrument is now ready to operate. Please further consult this manual for more information on the instrument's many features.

1.0 Introduction

1.1 Protection for Life

General Monitors' mission is to benefit society by providing solutions through industry-leading safety products, services and systems that save lives and protect capital resources from the dangers of hazardous flames, gases and vapors.

The safety products you have purchased should be handled carefully and installed, calibrated and maintained in accordance with this instruction manual. Remember, these products are for your safety.

1.2 Special Cautions and Warnings

This instruction manual includes numerous cautions and warnings that are included to prevent injury to personnel and prevent damage to equipment.

WARNING: TOXIC, COMBUSTIBLE, AND FLAMMABLE GASES AND VAPORS ARE VERY DANGEROUS. USE EXTREME CAUTION WHEN THESE HAZARDS ARE PRESENT.

1.3 Installation, Operation, and Maintenance

Before power up, verify wiring, terminal connections and stability of mounting for all integral safety equipment.

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur. Fault detection should be verified.

Periodic testing/calibrating should be performed per the manufacturer's recommendations and instructions.

When testing produces results outside of the manufacturer's specifications, re-calibration or repair/replacement of the suspect device(s) should be performed as necessary. Calibration intervals should be independently established through a documented procedure, including a calibration log maintained by plant personnel, or third party testing services.

2.0 Product Description

General Description

The Model IR700 infrared (IR) point detector is a microprocessor-based carbon dioxide gas detector, is calibrated at the factory and needs no routine field calibration. It is also relatively maintenance free, requiring only a periodic cleaning of the windows and re-zeroing to ensure dependable performance.

The IR700 continuously monitors carbon dioxide and provides a 4 to 20 mA analog signal proportional to 0 to 5,000 ppm gas concentration. Modbus communications provides additional information such as beam block percentage for preventative maintenance and event logging. Sensor data and status information from the IR700 can be transmitted to a variety of General Monitors' readout units.

The IR700 operates from an unregulated +24 volt DC supply.

Figure 3: Model IR700

Features and Benefits

This is a partial list of features and benefits for the Model IR700 infrared point detector:

- No routine calibration required
- Fail-to-safe operation
- 4-20 mA output
- Modbus communications link
- Optional HART interface
- Heated optics eliminate condensation
- Dirty optics indication
- Reading not affected by air velocity
- Interfaces directly with the IR4000S CO_2 monitor,,MC600 controller, IRFMD monitor, and TA502A trip amplifier

3.0 Installation

Receipt of Equipment

All equipment shipped by General Monitors is packaged in shock absorbing containers, which provide considerable protection against physical damage. The contents should be carefully removed and checked against the packing list. If any damage has occurred or there is any discrepancy in the order, please notify General Monitors as soon as possible. All subsequent correspondence with General Monitors must specify the equipment part number and the serial number.

Detector Location Considerations

There are no standard rules for detector placement, since the optimum detector location varies with the application. The customer must evaluate conditions at the facility to make this determination. If practical, the Model IR700 infrared point detector should be easily accessible for occasional integrity checks. The unit should be mounted horizontally so that dirt and dust do not build-up on the windows. Although the IR700 is RFI resistant, it should not be mounted close to radio transmitters or equipment that generates high magnetic or electrical fields.

Some other factors to consider when selecting a detector location:

- Emission temperature and vapor density of the gas. The IR700 should be located near the floor since carbon dioxide is heavier than air.
- Locate the IR700 where prevailing air currents contain the maximum concentration of gas.
- Observe the temperature range of the IR700 and locate the unit away from concentrated sources of heat or light.
- Mount the IR700 away from sources of excessive vibration.

WARNING: Each IR700 is completely tested at the factory. However, a complete system checkout is required upon initial installation and start-up to ensure system integrity.

3.1 Attaching the IR700 to a Junction Box or IR4000S CO_2

Before you can mount an IR700 device, you must first attach it to an IR700 junction box or an IR4000S CO_2 single point monitor.

CAUTION: To prevent damage by static electricity, avoid contact with circuit card components on the IR4000S. All wire connections should be made to the terminal blocks.

To Attach an IR700 to a Junction Box or IR4000S CO_2

1. Apply the supplied anti-seize thread lubricant to all conduit entries to prevent binding.

   Remove the cover from the junction box or monitor enclosure by loosening the four captive screws with a 5 mm Allen wrench, and lifting the cover straight up.

   Strip and trim the wires from the IR700 as needed and thread them into either the right or left wiring conduit of the enclosure.

   Once the wires are threaded into the enclosure, screw the IR700 securely into position. An example is shown below.

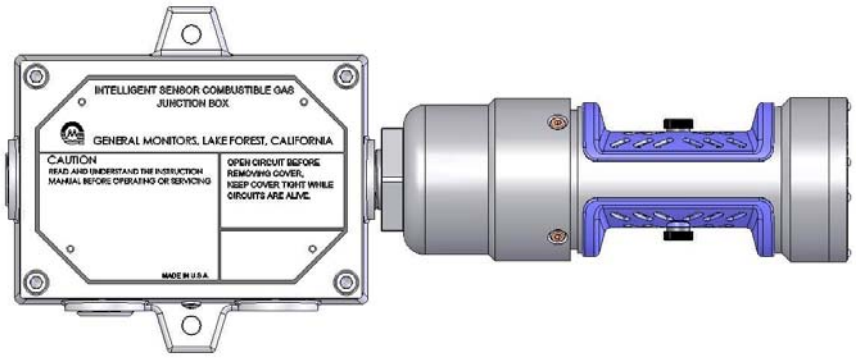

Figure 4: Model IR700 with a junction box

Fasten the IR700 wires to a wiring connector inside the enclosure. Once the two units are attached, you may replace the cover on the enclosure attached to the IR700 using the four captive screws, or leave it off until additional cabling from the enclosure is completed.

3.2 Mounting Instructions

The IR700 is mounted using the bolt holes on an attached junction box or monitor enclosure. The IR4000S CO_2 monitor is often mounted remote from the IR700 units, in order to locate it within easy reach and at eye level.

3.2.1 Mounting an IR700 with an Attached Enclosure

The following figure shows the overall and mounting dimensions for the Model IR700 with an attached junction box / IR4000S CO_2 enclosure.

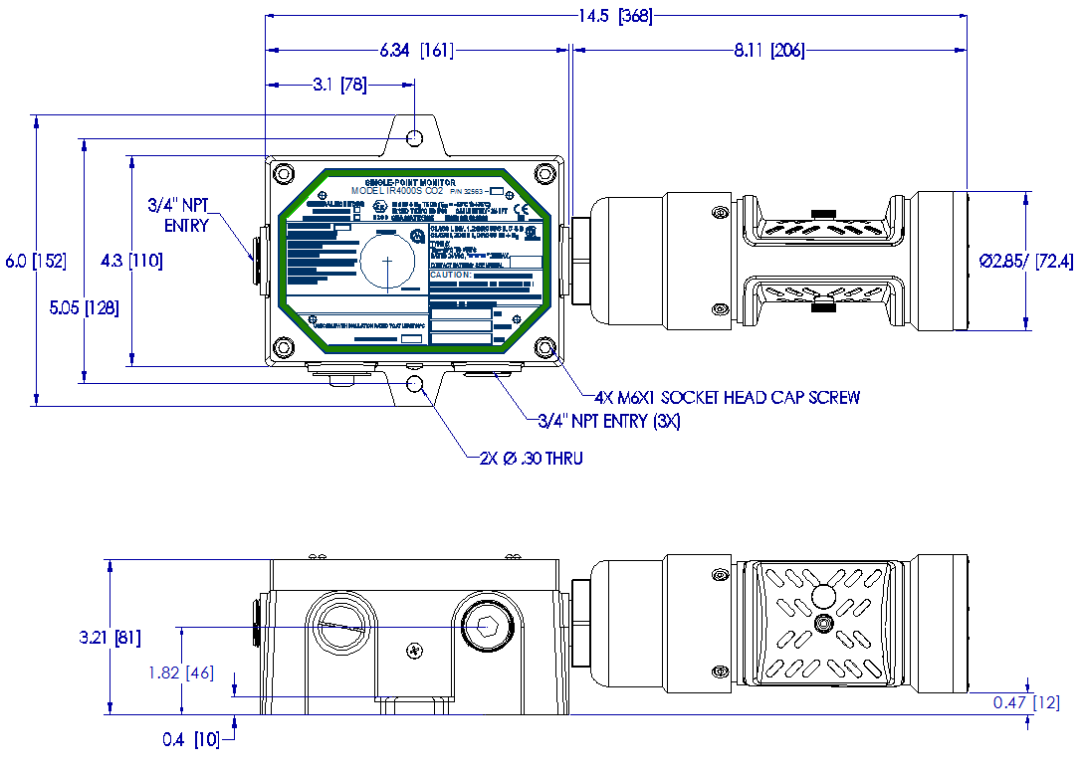

Figure 5. IR700 Mounting Dimensions

To Mount the IR700

The IR700 must rest horizontally to reduce the possibility of dirt and dust building up on the lens. Where applicable, for best step change response time, orient the IR700 so that the gas will flow into the slots in the splash guard.

Mount the attached junction box or IR4000S CO_2 enclosure using the two bolt holes.

NOTE: There is also a duct mounting kit available from General Monitors with separate instructions.

3.2.2 Cabling Safety Notices

CAUTION: The Model IR700 detector and Model IR4000S CO_2 monitor system contain components that can be damaged by static electricity. Special care must be taken when wiring the system to ensure that only the connection points are touched.

WARNING: Under **NO** circumstances should equipment be connected or disconnected when under power. This is contrary to hazardous area regulations and may also lead to serious damage to the equipment. Equipment damaged in this manner is not covered under warranty.

3.2.2.1 European Union (EU) Approved Cable Armor and Screens

Interconnecting cables must have an overall screen or screen and armor. Cable BS5308 Part 2, Type 2, or equivalent is suitable. Note that the terms 'screen' and 'shield' are equivalent for the purpose of this manual. The cable armor must be terminated in a suitable cable gland at the detector to ensure a positive electrical connection.

3.2.2.2 Cable Termination in Non-Hazardous Areas

- The cable **armor** must be connected to **safety earth** in the safe area.
- The cable screen (drain wire) must be connected to an instrument earth in the safe area.
- The power supply 0V return must be connected to an instrument earth in the safe area.
- The interconnecting cables should be segregated from power and other noisy cables. Avoid proximity to cables associated with radio transmitters, welders, switch mode power supplies, inverters, battery chargers, ignition systems, generators, switch gear, arc lights and other high frequency or high power switching process equipment.
- In general, maintain separation of at least 1 meter between instrument, instrument cables, and other cables. Greater separations are required where long parallel cable runs are unavoidable. Avoid running instrument cable trenches close to lightning conductor earthing pits.
- Complete all cable insulation testing before connecting the cable at either end.

3.2.3 Applying Sealants to Conduit Entries

Please keep the following warnings and cautions in mind when you install the IR700 and IR4000S CO_2 units, to make sure that the equipment maintains the appropriate seals for a Class I hazardous location.

WARNING: Each conduit run from an IR700 junction box or display unit within a hazardous location (and from a hazardous to a non-hazardous location) must be sealed so that gases, vapors, and/or flames cannot pass beyond the seal. The purpose of seals in a Class I hazardous location is to prevent the passage of gases, vapors, or flames from one electrical installation to another through the conduit system. For information on Class I location seals, see NEC Articles 501-5 and 500-3d.

WARNING: Unused cable entry holes in each IR700 junction box and IR4000S CO_2 must be sealed with approved explosion-proof stopping plugs. Red caps supplied by General Monitors are for dust protection only, and must not be left on the unit when installed.

CAUTION: Acetic acid will cause damage to metal components, metal hardware, ceramic ICs, etc. If damage results from the use of a sealant that contains acetic acid (RTV silicone), the warranty will be void.

CAUTION: To prevent corrosion due to moisture or condensation, it is recommended that the conduit connected to the display unit housing be sealed or contain a drain loop.

3.3 Wiring Connections

WIRE	WIRE COLOR	SIGNAL
1	BLACK	COM
2	GREEN	FIELD GROUND (FG)
3	RED	+24 V
4	WHITE	4-20 mA
5	BLUE	MOD1+
6	WHT/BLU	MOD1-
7	BROWN	CAL

Table 2: Wiring Chart

The IR700 operates on nominal power of +24 VDC. The customer must provide primary DC voltage power, unless a General Monitors readout/relay display module with an internal power supply is used. Since the IR700 is designed to continuously monitor gas levels, a power switch is not included in order to prevent accidental system shut down.

NOTE: Power should remain disconnected until all other wiring connections are made.

3.3.1 Power Connections

To supply power to the Model IR700 connect the red lead from the IR700 to the +24 VDC terminal on the power supply. Connect the black lead from the IR700 to the power supply Common. Refer to the manual of the power source being used, for more detailed instructions.

An internal diode protects the system in the event of inadvertent supply reversal.

3.3.2 4- 20 mA Output

A 4 to 20 mA output signal is provided by the Model IR700 and can be sent to a General Monitors' readout/relay display module or any industrial device that can accept a 4 to 20 mA

signal for computer based multi-point monitoring. The Analog Output connection provides a signal for use in displaying ppm gas readings, special operation or fault conditions. The maximum load for the Analog Output signal is listed in Section 9.3, Specifications.

To access the 4-20 mA signal, connect the white lead from the IR700 to the signal-in terminal of the input unit. Refer to the manual of the display or other device being used for detailed instructions.

Connect the black lead from the IR700 to the device Common. The Common connection serves both the analog signal and the power connections.

3.3.3 Modbus Interface

To access the Modbus (Modbus-RTU) interface, connect the blue lead from the IR700 to the Modbus (+) terminal and the blue/white lead to the Modbus (-) terminal on the customer's Modbus capable device. For a description of the data available from the IR700 and the programming interface, refer to the separate IR700 Modbus Programming Guide.

3.3.4 HART Interface

A standard HART interface is available which provides a digital data channel at 1200 baud over the 4-20 mA current loop. Refer to the IR700 HART Field Device Specification for additional information.

3.3.5 Calibration Interface

The IR700 also provides a brown CAL lead for calibration. The brown lead from the IR700 must be connected to the powered side of a switch so that when the switch is activated, the brown lead is grounded. General Monitors supplies a junction box or monitor with an integral magnetic switch to ease the connection of the IR700 in the field (Figure 6).

3.4 Applying Power

Before applying power to the system for the first time, all wiring connections should be checked for correctness. Upon initial power-up or after a fault condition has been corrected, the unit will enter a start-up mode for 2 minutes before returning to normal operation (Analog output will be 0 mA for a non-HART configuration and 1.25 or 3.5 mA for a HART configuration).

After power is applied, the IR700 should be allowed to stabilize for approximately 60 minutes while the unit attains the proper operating temperature. After stabilization, it is recommended that the IR700 be zeroed, per the procedure in Section 4.1 (step 1 only). A gas check should then be performed to ensure that the unit is operating properly. Use the General Monitors gas check kit (P/N 31478-1) to perform this check. If the unit does not respond properly, calibrate per the procedure in Section 4.1.2 (steps 1-4).

- When connecting the IR700 to a safety system, the +24 VDC (red) wire should be the last wire connected and first wire disconnected when removing the unit to protect the system from shorting.

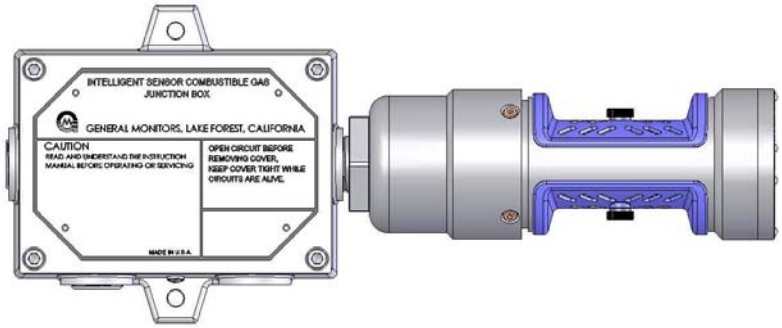

Figure 6: IR700 with Junction Box

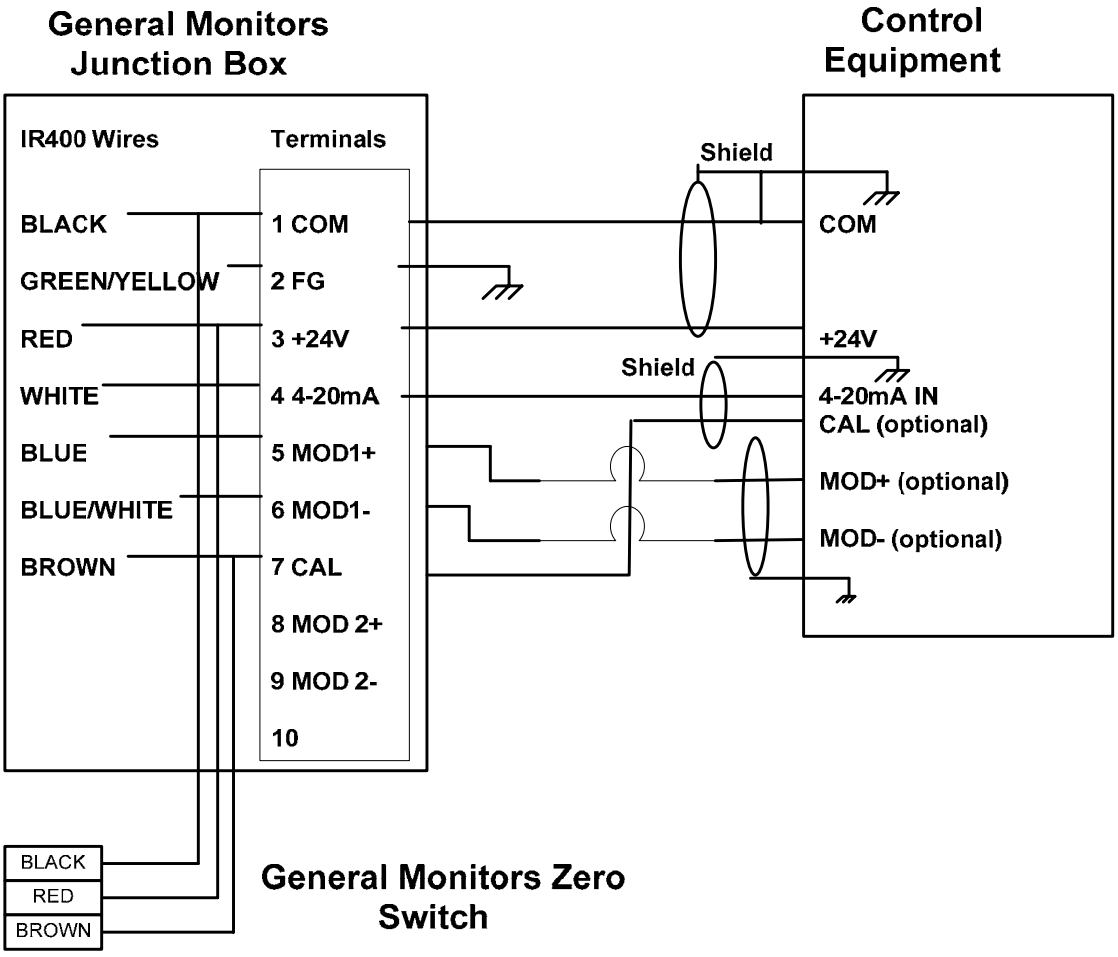

Figure 7: Wiring Diagram from IR700 to Control Equipment

4.0 Operation and Configuration

The methods used to operate and configure the IR700 will vary depending on whether you are using the IR700 as part of an IR4000S CO_2 monitoring system or as a stand-alone unit attached to a junction box and control room devices. Separate instructions are provided in this chapter for each situation.

- *If your IR700 is part of an IR4000S CO_2 system*, you can operate and configure both the IR700 and the IR4000S using the IR4000S menu options and LED display. You can also send Modbus or HART commands to the IR4000S from connected control room devices, to perform all the menu-driven functions, plus additional ones.
- *If your IR700 is a stand-alone unit attached to a junction box*, you can use the magnetic switch attached to the junction box for zeroing and calibration. You can also send Modbus or HART commands to the IR700 from control room devices to perform zero, calibration, gas checks, and configuration tasks.

NOTE: This chapter describes how to use the junction box magnetic switch for stand-alone IR700 operation; the IR4000S CO_2 manual describes how to use the IR4000S CO_2 menus for IR700 system operation and configuration.

4.1 Zeroing, Gas Check Tests, and Calibration

Each IR700 is calibrated at the factory. However the detector will need occasional zeroing as well as gas check tests and calibration after initial installation to make sure it is working properly. Before zeroing or calibration, always check that the optics path is clear and the windows are clean. These are the most important operations to ensure that the IR700 is measuring accurately.

Depending on your system configuration, you can use menus, Modbus/HART commands or magnetic switch selection to initiate zeroing, gas checks and calibration, as described later in this chapter. Some general guidelines are provided here that are useful no matter what method is used.

4.1.1 Gas Check Test Guidelines

Running a gas check test enables you to verify whether the detector is functioning correctly, by applying a known gas concentration and monitoring the ppm reading while keeping the alarm and warning relays disabled. To conduct the test, you can use the General Monitors gas check kit with portable purge calibrator equipment.

NOTE: The FMD and IR4000S CO_2 have a relay inhibit mode that will turn off the Warn and Alarm relay but the IR700 current loop will still transmit the gas concentration level. This could cause alarms on control room equipment.

4.1.1.1 Portable Purge Calibrator Equipment

The portable purge calibrator is a compact, accurate and safe system. The purge is filled with nitrogen. The lecture bottle is filled with a standard 50% full scale mixture of gas/air. Using

known gas/air mixtures reduces the likelihood of error in field calibration. The hose and cup adapter that are included allow for quick calibrations and gas checks.

4.1.2 Calibration Guidelines

Calibrating the detector corrects any errors that may be affecting the ppm measurement that is taking place. You should use the General Monitors gas check kit for calibration. Section 4.1.1.1 describes the gas check kit equipment in more detail. You may need to calibrate the IR700 detector under several circumstances.

- If the gas check test indicates that the detector needs adjustment.
- If you are moving the detector to a higher altitude location (every 1000 feet difference in altitude requires recalibration).

4.2 IR700 Stand-alone Operation and Configuration

The IR700 does not have built-in operation and configuration menus without an IR4000S CO_2. However, zeroing and calibration can be accomplished using the Zero (magnetic) Switch / LED on the junction box that is directly attached to the IR700. You should zero the Model IR700 detectors occasionally to assure proper detector operation. Calibration is necessary if gas check readings show the unit is reading inaccurately.

In addition, many operational functions are available using the Modbus or HART interface from a control room device, as described in separate manuals (available from our website).

4.2.1 To Zero and Calibrate a Stand-alone IR700 Using a Magnetic Switch

This procedure describes how to use the IR700 junction box magnetic switch to zero and calibrate the IR700. Once zeroing or calibration begins, the alarm and warning relays are automatically kept disabled, and the analog signal is held 1.5 mA. The HART 3.5 mA configuration is not compatible with the magnetic switch. As you follow the procedure steps, refer to the figure shown on the following page for the LED indicator.

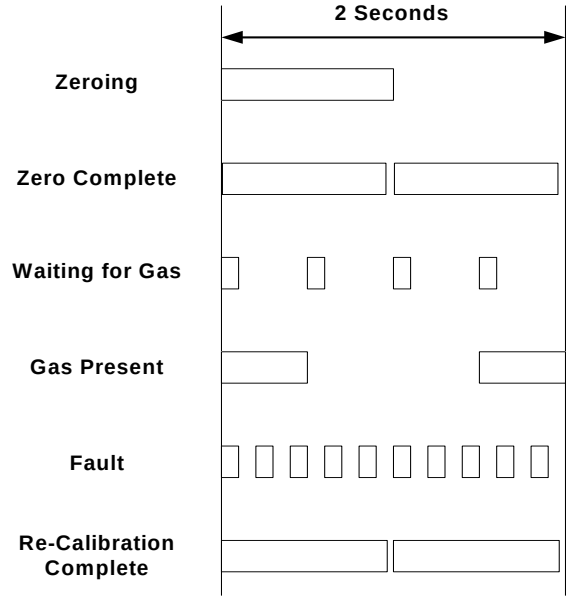

Figure 8. IR700 Zero Switch / LED During Zeroing and Calibration

Review the general guidelines in Section 4.1 on Zeroing, Gas Check Tests, and Calibration. Make sure the windows are clean and there is nothing blocking the optical beam.

4.2.2 Zero Only

The junction box used with the IR700 is fitted with a switch to zero the detector.

Zero the Unit. To insure a true zero and maintain IR700 accuracy, the IR700 must be purged with nitrogen for a sufficient time to remove all naturally occurring carbon dioxide. Apply the General Monitors magnet that was included with the unit to the Zero Switch / LED for approximately three seconds. The LED in the switch will light to show proper placement.

- Remove the magnet and the LED will flash on for one second and off for one second to indicate that the unit is attaining a zero value (*Zeroing* in Figure 8).
- When the unit has finished zeroing, the LED will turn on and flash off quickly once per second for 30 seconds (*Zero Complete*).

NOTE: If an error occurs during the zeroing/calibration sequence, the LED will flash on and off rapidly (*Fault*).

4.2.3 Calibration

1. **Zero the Unit**. Flow nitrogen to the detector. Apply the General Monitors magnet that was included with the unit to the Zero Switch / LED for approximately three seconds. The LED in the switch will light to show proper placement.
   - Remove the magnet and the LED will flash on for one second and off for one second to indicate that the unit is attaining a zero value (*Zeroing* in Figure 8).
   - When the unit has finished zeroing, the LED will turn on and flash off quickly once per second for 30 seconds (*Zero Complete*).

NOTE: If an error occurs during the zeroing/calibration sequence, the LED will flash on and off rapidly (*Fault*).

2. **Return to Normal Operation or Start Calibration.** If the magnet is not applied again, the unit will return to normal operation. To continue on and calibrate, apply the magnet again and the unit will enter the calibration mode.

   The LED will flash off quickly once every half-second while the unit is waiting for gas to be applied (*Waiting for Gas*).

3. **Apply Gas**. Apply 50% full-scale gas using a Gas Check Kit with portable purge calibrator equipment.
   - When the unit detects the gas, the LED will flash on for a half second every one and one-half seconds (*Gas Present*).
   - If the unit does not detect the gas, the LED will flash off quickly once every half-second while the unit is still waiting for gas to be applied (*No Gas Error*).
   - Once calibration has been completed, the LED will turn on and flash off once every second (*Calibration Complete*).
4. **Return to Normal Operation**. Remove the gas and the unit will return to normal operation once the gas has fallen below 20% of full scale.

4.3 Gas Check Mode

1. Send Modbus or HART gas check command.
2. When the unit enters gas check mode, AO will be 3.5 mA for the HART 3.5mA configuration or 1.5 mA for other configurations. Apply 50% full scale gas using a gas check kit with portable purge calibrator equipment.
3. Once the detector is placed in gas check mode and the gas is applied, monitor the ppm reading for the detector to see if it is functioning properly using the junction box or IR4000S CO_2 display or Modbus or HART commands. When the reading is stabilized, it should be 50% full scale.
4. Remove the gas.

The unit will return to normal operation when the concentration drops below 20% of full scale.

4.4 Detector Response Time

A valid response time of a gas detector must take into account a static gas presence as it occurs in the field with a gas leak. Tests performed on site use a flow method to verify detector function only as gas enters the optical path, with its splashguard in place. With regard to the time response, this specification is obtained by testing the gas detector, with a splashguard, using test methods that are compliant with agency performance standards. A chamber is filled with a known concentration of gas and the IR700 is then exposed to the gas. This method instantly fills the optical path of the detector to achieve the stated response times for the IR700.

The products offered by GM are not for the purpose of testing response time, but as a method to allow a user to check that the unit is responding to gas. If it is required to demonstrate a reading of 50% full scale on-site, this can be achieved using the calibration cup. However you need to allow adequate time for the test gas to reach the detector. This time is due to the ambient air located in the optical path of the detector having to be replaced progressively by the test gas. This replacement of ambient air is quicker at the beginning but longer for the last percentage because it is linked to the slow replacement of air dilution by the test gas. This test is only to indicate a gas level of 50% full scale within the calibration cup and is not a reflection of the response time of the detector.

5.0 Maintenance

The Model IR700 is calibrated at the factory and is fail-to-safe; once it is correctly installed and calibrated upon start-up, it requires little maintenance other than periodic cleaning, gas checks, zeroing and recalibration to ensure system integrity. Integrity checks can be performed using General Monitors Gas Check Kit (P/N 31478-1).

WARNING: Disconnect or inhibit external devices such as Trip Amplifiers, PLC's, or DCS systems before performing any maintenance.

NOTE: If an optical fault still occurs after cleaning and re-zeroing of an IR700 detector is complete, contact the factory. The system's full two-year warranty will be voided if customer personnel or third parties damage the system during repair attempts or maintenance activities. Gassing into the screened splashguard will not provide a stable or accurate reading.

5.1 Developing a Maintenance Schedule

Maintenance requirements will vary with each installation; General Monitors recommends that a schedule for periodic maintenance be established and followed, and that a maintenance logbook be kept for each unit in operation.

More frequent cleaning and calibration checks are recommended if the equipment is affected by unusual environmental conditions such as mud collecting on the sensor head, sensors accidentally being painted over, etc.

5.2 Gas Checks, Zeroing and Recalibration

The Model IR700 is calibrated at the factory and needs only occasional recalibration after initial installation and start-up.

- For detailed instructions on initiating gas checks, zeroing and calibration using the IR4000S CO_2 menus, see the user manual for the IR4000S CO_2.
- For instructions on zeroing and recalibrating a stand-alone IR700 using the magnetic switch on an attached junction box, see Section 4.2.1.
- For information on the IR700 Modbus register *Operating Mode* commands for gas checks, zeroing and calibration, refer to the separate Modbus programming guide.

5.3 Cleaning and Lubricating the IR700 and IR4000S CO_2 Units

5.3.1 Cleaning the IR700 and IR4000S CO_2 Units

The IR700 optical windows can be cleaned by removing the splashguard that covers them, then gently wiping them with a soft, clean cloth or cotton swab that has had a commercial window cleaning solution applied; water or ethanol are examples of suitable solvents. You can remove particulate matter from the IR700, detector accessories, and IR4000S CO_2 units using an appropriate halogen-free solvent, such as water or ethanol. Accessories should be thoroughly dried with oil-free compressed air, if necessary, before refitting them to the detector.

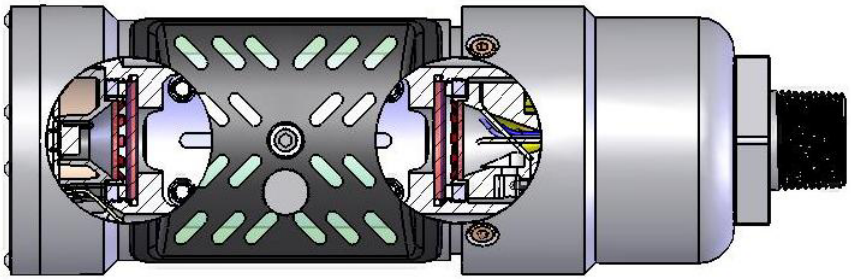

Figure 9. IR700 optical window locations

NOTE: Do not clean the windows while an IR700 unit is zeroing or in recalibration mode. The unit must be re-zeroed after cleaning.

5.3.2 Lubricating IR700 and IR4000S CO_2 Units

If the neoprene rubber gasket (O-ring) in the cover of the IR4000S CO_2 enclosure is found dry, it should also be lubricated with the anti-seize thread lubricant that is included with the IR700/IR4000S CO_2 units, or is available on order from General Monitors P/N 2085.

As an alternative to grease, PTFE (Teflon) tape may be used provided that it complies with installation requirements.

5.4 Storage

The Model IR700 Gas Detector and IR4000S CO_2 Monitor System should be stored in a clean, dry area, and within the temperature and humidity ranges noted for environmental specifications. Insert the red dust caps into any vacant cable entry holes while the unit is stored.

6.0 Troubleshooting

The IR700 will alert the operator that there are problems in a number of ways. The table on the following page shows the value for the analog output, the value read through Modbus register 2 (if Modbus is being used), and the fault code, shown as F and a number, on the IR4000S CO_2 display (if connected).

If the IR700 is connected to a zero switch, then the LED in the zero switch will blink at a rate of 5 flashes per second to show that the detector needs attention.

HART Troubleshooting

1. Verify that the IR700 is configured for HART
2. Verify that the HART modem or HART handheld device is working by checking it against another HART field device
3. Verify that the HART software or handheld device has the Device Description (DD) for the IR700. If the DD is not present, download it from the HART Communication Foundation (HCF) website (add web address)
4. Verify the IR700 wiring
5. Verify that power is off when removing or attaching wires
   - Red to power
   - Black to common
   - White to a 250 ohm resistor, and the other end of resistor to common. Resistor tolerance should be +/-5% or less.
   - Verify HART modem or 475 wiring: Leads are across the 250 ohm resistor
   - After verifying the IR700 wiring, verify that power is on to the IR700 and to the HART modem or handheld device
6. Verify the IR700 4-20 mA output. When no gas and no faults are present, a voltmeter across the 250 ohm resistor will read 1.0 volt DC.

Table showing the fault conditions and corrective action required:

FAULT CODE	MODBUS FAULT FLAG REGISTER 2	ANALOG OUTPUT (mA)		DESCRIPTION	POSSIBLE CAUSE	CORRECTIVE ACTION
		HART	non-HART			
F0	Bits 3 & 14	2mA for 30s then 1.25mA	2mA for 30s then 0mA	Gas Concentration is Excessively Negative	1) Fouling of the detector windows or beam path is excessive and requires attention	1) Clean detector beam path and windows.
F1	Bits 0 & 1	2	2	Gas Concentration is Negative	1) Detector windows or beam path are beginning to be obscurred.	1) Clean detector beam path and windows.
F2	Bit 6	1.25	0	Failed to Complete Calibration	1) Cal bottle empty and time-out occurred 2) Failed to remove gas at end of CAL and time-out occurred. 3) Leaky CAL cup resulting in unstable signal. 4) Attempted to CAL with too much wind resulting in unstable signal.	1) Obtained filled CAL bottle and re-CAL. 2) Remove gas when directed. 3a) Check CAL cup for proper seating on unit. 3b) Check CAL cup seal and replace CAL cup if damaged. 4) Calibrate at a much less windy time or shield the unit and CAL cup from the wind.
F3	Bit 2	2mA for 30s then 1.25mA	2mA for 30s then 0mA	Beam Block	1) Detector windows or beam path are blocked by dirt, spider webbing or other foreign matter. 2) Detector or source failure.	1) Clean detector beam path and windows. 2) The IR700 must be returned to the factory or authorized service center for repair.
F4		1.25	0	Communications Fault	1) 4-20 mA miswired 2) 4-20 mA output is 0 mA	1) Check and correct wiring 2) Correct fault condition in IR700
F5	Bit 4	1.25	0	CAL Wire (brown) Shorted	1) CAL Wire (brown) not in connector	1) Check and ensure proper connection of wire to board connector
F6	Bit 5	1.25	0	Low Supply Voltage	1) Power supply not outputing greater than 20VDC. 2) Voltage loss due to wiring.	1) Check the supply voltage and replace power supply if necessary 2) Check the supply voltage at the IR700 field and adjust supply to +24VDC at the IR700 or replace wiring with larger gauge.
F7	Bits 9 - 13 & 15	1.25	0	Electronics Error	1) Internal memory glitch 2) Internal error with the electronics.	1) Cycle power, wait 2 minutes, if the fault clears then check all menu settings and recalibrate the IR700. 2) Call your local General Monitors representative for advice.
F8	Bit 7	1.25	0	Failed to Zero	1) Unstable signal due to gas present.	1) Ensure nitrogen is available for zeroing or provide nitrogen to the IR700 during zeroing.
F9	Bit 8	1.25	0	CAL Check Period Exceeded	1) Test gas still present after gas check completed.	1) Remove the gas

7.0 Modbus Interface

The IR700 has a single Modbus compatible interface for connection to control room equipment such as programmable logic controllers (PLCs).

A separate programming guide for the IR700 Modbus registers is available from the General Monitors website.

8.0 Customer Support

Area	Phone/Fax/Email
UNITED STATES	
	Toll Free: +1-800-446-4872
Corporate Office:	Phone: +1-949-581-4464
26776 Simpatica Circle	Fax: +1-949-581-1151
Lake Forest, CA 92630	Email: info@generalmonitors.com
	Phone: +1-281-855-6000
9776 Whithorn Drive	Fax: +1-281-855-3290
Houston, TX 77095	Email: gmhou@generalmonitors.com
UNITED KINGDOM	
Heather Close	
Lyme Green Business Park	Phone: +44-1625-619-583
Macclesfield, Cheshire,	Fax: +44-1625-619-098
United Kingdom, SK11 0LR	Email: info@generalmonitors.co.uk
IRELAND	
Ballybrit Business Park	Phone: +353-91-751175
Galway	Fax: +353-91-751317
Republic of Ireland	Email: info@gmil.ie
SINGAPORE	
No. 2 Kallang Pudding Rd.	Phone: +65-6-748-3488
#09-16 Mactech Building	Fax: +65-6-748-1911
Singapore 349307	Email: genmon@gmpacifica.com.sg
MIDDLE EAST	
LOB12, #G20	
P.O. Box 61209	Phone: +971-4-8143814
Jebel Ali, Dubai	Fax: +971-4-8857587
United Arab Emirates	Email: gmme@generalmonitors.ae

Table 3: GM Locations

9.0 Appendix

9.1 Warranty

General Monitors warrants the Model IR700 to be free from defects in workmanship or material under normal use and service within two (2) years from the date of shipment.

General Monitors will repair or replace without charge any such defective equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective equipment will be made by General Monitors' personnel.

Defective or damaged equipment must be shipped prepaid to General Monitors' plant or representative from which shipment was made. In all cases this warranty is limited to the cost of the equipment supplied by General Monitors. The customer will assume all liability for the misuse of this equipment by its employees or other personnel.

NOTE: The Model IR700 Infrared Point Detector is easy to install; however, you should read and understand this manual before attempting to install or operate the device. It includes important safety information.

All warranties are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without General Monitors' approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness and the express warranty stated herein are in lieu of all obligations or liabilities on the part of General Monitors for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.

9.2 Principle of Operation

Most gases absorb infrared radiation in specific wavelengths or bands that are characteristic of the chemical structure of molecules in the gas. The Model IR700 is based on measuring absorption of infrared radiation passing through a volume of gas.

Absorption of the radiation follows the Beer - Lambert Law, which states “the transmittance T of radiation through an absorbing medium decreases exponentially by the product of the extinction coefficient A, the concentration C and the path length L”:

T = exp(-ACL)

The Model IR700 uses a dual source, single detector measurement method. One source operates at a wavelength where absorption of a specific gas (or gases) occurs (the active wavelength). The reference source operates at a wavelength that is adjacent to the active wavelength but not absorbed by the gas (or gases). By comparing the signals from these two sources the concentration of the gas can be measured using the differential absorption technique.

This method of gas detection comes under what is commonly known as the non-dispersive infrared (NDIR) absorption principle. The reference wavelength is chosen suitable to compensate for any interference that can otherwise occur from atmospheric variation (e.g. humidity, dust, snow, fog, steam, temperature, etc.).

Control Electronics

The Model IR700 operates from an unregulated +24 VDC (nominal) input, which is fed to an onboard power-supply that produces all of the necessary voltages within the unit. The microprocessor constantly monitors the infrared wavelengths and performs mathematical operations on these values in conjunction with values obtained during the factory set-up process.

The microprocessor generates output information and feeds it to the digital analog converter to produce a 4 to 20 milliampere (mA) signal that is proportional to 0 to 100% full scale of the detector. The microprocessor program also monitors other conditions such as the supply voltage and the optical path integrity.

The Model IR700 provides a two-wire RS-485 addressable communications link conforming to the Modbus protocol that is used to monitor the IR700’s status and settings in order to simplify installation and maintenance.

9.3 Specifications

9.3.1 System Specifications

Detector Type:	Infrared absorption
Detector Life:	Greater than 5 years
Measuring Range:	0 to 5000 ppm Consult factory for other ranges.
Accuracy @ 25º C:	±5% Full Scale (FS) ≤ 50% FS, ±10% FS > 50% FS
Warranty:	Two years
Gas Calibration	2500 ppm ± 25 ppm carbon dioxide; nitrogen for zero
Readout/Relay Display Modules:	IR4000S CO_2: display and relay alarms MC600 TA502A: Single Channel, Zero Two Series
Faults Monitored:	Re-calibration or Zero Error Gas Check Timeout Optics Failure/Blockage Low Supply Voltage Reference or Active Lamp Failure Heater Failure Negative drift Program Memory Checksum Error (EPROM) Data Non-Volatile Memory Checksum Error (EEPROM) Short Circuit on CAL Wire
Response Time: *(With standard splash guard in place and 100% full scale gas applied)*	T50 ≤ 4 seconds T90 ≤ 8 seconds
Approvals:	CSA CE Marking ATEX IECEx

9.3.2 Mechanical Specifications

Length:	8.87 inches (225 mm)
Diameter:	2.9 in (74 mm)
Weight:	3 lbs (1.35 kg) for aluminum 6 lbs (2.7 kg) for stainless steel
Mounting:	3/4" NPT threads
Enclosure:	Marine Aluminum or Stainless Steel; Explosion proof, IP66, TYPE 4X

9.3.3 Electrical Specifications

Input Power:

absolute min	20 V
nominal	24 V
absolute max	36 V
max. wattage	4.8 W @ +24 VDC
max. current	200 mA @ +24 VDC
ripple maximum allowed	1 V pk-pk

Analog Signal:

Range	0 - 21.7 mA
Load (max. resistance)	600 Ω

Current Level (mA)

0	Startup mode and critical fault for non HART unit
1.25*	Startup mode and critical fault for HART unit
1.5*	Zero, Calibration and Gas Check Mode
2*	Dirty Optics
4 – 20	0 – 5000 ppm
21.7	Overrange

* HART units can be configured to a minimum output current of 3.5 mA if the host equipment is incapable of working below this level.

Electrical Classification:	Class I, Divisions 1 & 2, Groups B, C and D (Ta = -40°C to +75°C) Type 4X Ex d, IIB+H_2 T5 Gb, IP66 (Ta = -60°C to +75°C) Ex t IIIC T100°C Db
RFI/EMI Protection:	Complies with EN55011, EN50270

9.3.4 Analog Current Output

The following table shows the values of the analog output when in certain modes or fault conditions.

Condition Type	Non-HART Units	HART Units	HART Override Mode*
Start Up, Fault	0 mA	1.25 mA	3.5 mA
Zero, Gas Check or Cal	1.5 mA	1.5 mA	3.5 mA
Dirty Optics	2.0 mA	2.0 mA	3.5 mA
0-100% ppm	4 – 20 mA	4 – 20 mA	4 – 20 mA
Over-range	21.7 mA	21.7 mA	21.7 mA

Table 4: Analog Current Output

* *HART units can be configured to a minimum output current of 3.5 mA if the host equipment is incapable of working below this level.*

9.3.5 Cable Requirements

It is the responsibility of the facilities engineer to comply with all regulatory, legal, and safety issues concerning appropriate wiring for the facility.

The sample calculations are for reference only. Customers must derive the distance from supply to device based on cable specifications, expected maximum ambient temperature and cable temperature rise, estimated connection losses, allowances for error in distance measurement, and other variables particular to the customer installation.

Sample Calculations for Power Cable
V_supply = 24 VDC, V_device = 20 VDC, I_device_max = 0.20 A, cable resistance per meter = 9.00 ohms per meter at maximum ambient temperature for 2.5 mm^2 cable

Maximum distance from supply to Receiver = (1/2) x (V_supply – V_device) / (I_device_max x cable resistance per meter)

Maximum distance = (1/2) x (24 – 20) / (0.20 x 9.00 / 1000) = 1110 meters

Sample maximum distances from supply to device

Max Wire Size	16 AWG	14 AWG	1.5 mm2	2.5 mm2
Typical Resistance	5.00 ohms / 1000 ft	3.00 ohms / 1000 ft	16.0 ohms / 1000 m	9.00 ohms / 1000 m
Distance	2000 feet	3330 feet	630 meters	1110 meters

Sample Calculations for Analog Output Cable
Maximum load is 600 ohms. If the AO device has an input impedance of 500 ohms, the total cable resistance must not exceed 100 ohms, where maximum load = device load + cable resistance. For 16 AWG cable with resistance of 5 ohms / 1000 feet, the maximum distance from detector to AO input device is (Maximum load – AO device load) x (cable unit distance / cable unit resistance) / 2 = distance from detector to AO input device = (600 – 500) x (1000 / 5) / 2 = 10,000 feet.

AWG	OHMS/1000 FT	FEET	METERS
#20	11	4,550	1,390
#18	7	7,140	2,180
#16	5	10,000	3,050

9.4 Environmental Specifications

Temperature Range:

Operating	-40°F to 122°F (-40°C to +50°C)
Storage	-76°F to 185°F (-60°C to +85°C)
Humidity Range:	10 to 95% RH non-condensing Accuracy is not affected by humidity as long as no condensation accumulates on the windows

9.5 Communications

9.5.1 RS-485 Interface for Modbus

The Model IR700 has built-in serial communications in the form of a half duplex RS-485 digital serial interface designed to conform to EIA-485 specifications. The format is in binary data transferred at 9600 baud with 1 start bit, 8 data bits, 1 stop bit and no parity for Modbus RTU communication. A programming guide is available from the General Monitors website that gives details on all the available Modbus RTU commands.

9.5.2 HART

The IR700 HART Field Device Specification provides details on HART commands. The specification is available from the General Monitors website.

9.6 Engineering Documentation

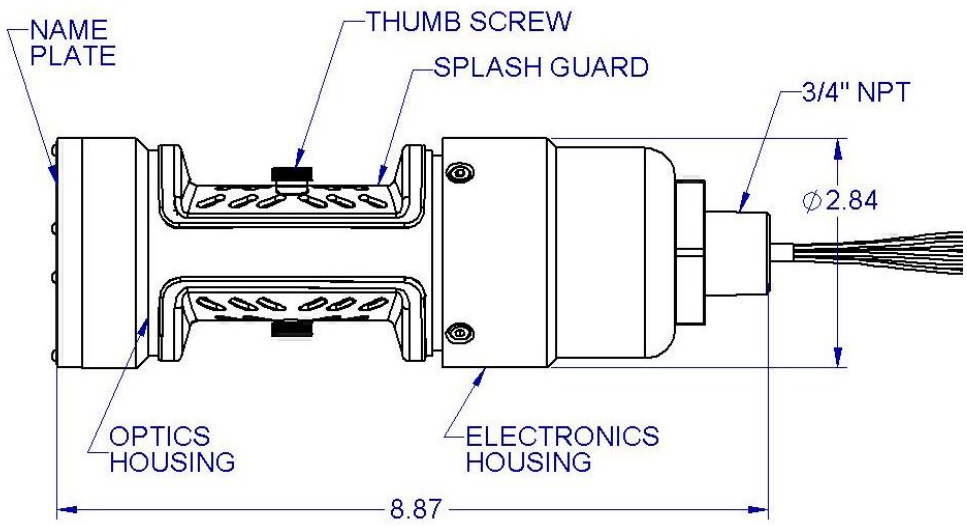

Figure 10: Outline and Dimensional Drawing, IR700, inch measurements

9.7 Ordering Information

9.7.1 System Components

Description	Part Number
Model IR700 Infrared Point Detector	**IR700**
Instruction Manual - Model IR700	**MANIR700**
Model IR700 HART Field Device Specification	**MANIR700H**
Model IR700 Modbus Programming Guide	**MANIR700M**
Multi-Channel Controller for Hydrocarbon, H2S and Toxic Gas Monitoring Applications	**MC600**
TA502A Single Channel Zero Two Series Trip Amplifier	**TA502A**
IR4000S CO_2 Single-point Monitor	**MANIR4000SCO2**

9.7.2 Spare Parts and Accessories

To order spare parts and/or accessories, please contact the nearest General Monitors representative, or General Monitors directly, and give the following information:

1. Part Number
2. Description
3. Quantity

9.7.3 Recommended Spare Parts for One (1) Year

31037-1	Double-Magnet Assembly if a zero switch is used

9.7.4 Accessories

31305-1	Junction Box with magnetic switch, CSA/FM
31305-2	Junction Box without magnetic switch, CSA/FM
31306-1	Duct Mount Junction Box
31420-1	Flow Block for gas sampling system
31421-3	Junction Box with magnetic switch, ATEX
31421-4	Junction Box without magnetic switch, ATEX
31478-1	IR700 Gas Kit
31545-1	Rain Guard Assembly
32545-1	Splash Guard standard
32545-2	Splash Guard no screen
32554-1	Calibration Cup / Flow Block

ADDENDUM
Product Disposal Considerations

This product may contain hazardous and/or toxic substances.

EU Member states shall dispose according to WEEE regulations. For further General Monitors' product WEEE disposal information please visit: www.generalmonitors.com/customer_support/faq_general.html

All other countries or states: please dispose of in accordance with existing federal, state and local environmental control regulations.